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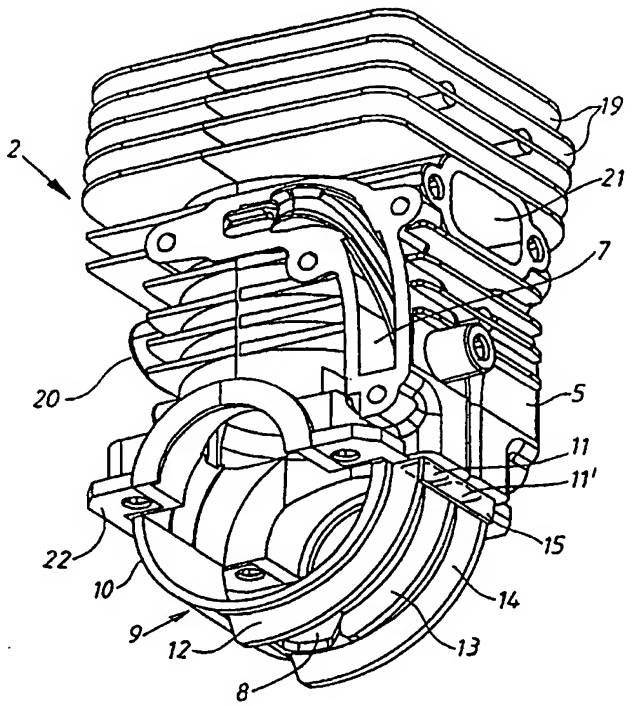
(54) Title: CRANKCASE SCAVENGED INTERNAL COMBUSTION ENGINE

(57) Abstract

A crankcase scavenged internal combustion engine, mainly intended for a handheld working tool, such as a chain saw, with an engine body (2) composed of at least one crankcase body (3, 4) and a cylinder body (5), which are joined together, and the engine is equipped with so called elongated scavenging ducts (6, 7, 6', 7'), which over some part of their length, i.e. a crankcase part (6, 6'), extend in the crankcase body (3, 4) and have their inlet (8) there, and over another part of their length, i.e. a cylinder part (7, 7'), extend in the cylinder body (5). For the sake of clarity the crankcase body (3) is not shown, however an insert part (9) is, which together with the inner side of the crankcase body (3) is forming the crankcase parts (6, 6') of the scavenging ducts. In the shown example the duct (6) is separated by side walls (12, 13), an inner wall (10) as well as the inner side of the crankcase body. Generally this means that the crankcase part (6, 6') of at least one scavenging duct to a great extent is composed of an insert part (9) with at least one inner walk (10) facing the crankshaft assembly and provided with the inlet (8), so that the crankcase part (6, 6') of the scavenging duct is composed of the insert part (9) alone or in combination with the inner side of the crankcase body, and leads from the inlet (8) to an outlet (11, 11') intended to connect to the cylinder part (7, 7') of the scavenging duct.



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CRANKCASE SCAVENGED INTERNAL COMBUSTION ENGINE

Technical field

The subject invention refers to a crankcase scavenged internal combustion engine, mainly intended for a handheld working tool, such as a chain saw, with an engine body composed of at least one crankcase body and a cylinder body, which are joined together, and the engine is equipped with so called elongated scavenging ducs, which over some part of their length, i.e. a crankcase part, extend in the crankcase body and have their inlet there, and over another part of their length, i.e. a cylinder part, extend in the cylinder body. Generally the crankcase scavenged internal combustion engine is of two-stroke type, but it could also be a four-stroke engine as well as other applications not only meant for a handheld working tool.

Background of the invention

Crankcase scavenged internal combustion engines with so called elongated scavenging ducts, i.e. scavenging ducts starting in the crankcase part, usually in its lower parts, are known since a long time. The elongated scavenging ducts will under certain conditions have a favourable effect on the scavenging and can thereby reduce both the fuel consumption and the exhaust emissions. The scavenging ducts in the crankcase part are produced in that a vertically-split crankcase is provided with cavities on both sides of the parting plane. When assembling the crankcase a large continuous scavenging duct is thus created by the both cavities. In case the sealing in the parting plane is drawn right up to the inner side of the crankcase it will split the large duct into two scavenging ducts which often is preferable. Generally the inlet of the scavenging duct is formed already during the casting process.

This is rational from a productional point of view but it requires a specific crankcase for each motor application with varying placement of the inlet. For, it is preferable to adapt the length of the scavenging duct and/or the cross-section area of each application, in order to in this way obtain optimum engine performance. Such an adaption for a specific crankcase can be achieved only by machining the inlet of the scavenging duct instead of pre-casting it and this is costly. In the vertically-split crankcase a bearing position for each crankshaft bearing is positioned in each of the crankcase halves.

There are also internal combustion engines having a so called horizontally-split crankcase. It means that the crankcase is split at the centre axis of the crankshaft and consists of only one part. In that case a cylinder part is containing the top crankcase half down to the centre axis of the crankshaft. In this manner the engine body is thus made of only two parts instead of three when a vertically-split crankcase is used. The bearing positions of the crankshaft bearings are thus positioned in each part of the engine body and the bearings are clamped between the engine body parts. The applicant does not know of any example of an internal combustion engine with a horizontally-split crankcase having elongated scavenging ducts, even if this is preferable from many aspects.

Purpose of the invention

The purpose of the subject invention is to substantially reduce the above outlined problems, and to achieve advantages in many respects.

Summary of the invention

The above mentioned purpose is achieved in that the crankcase scavenged internal combustion engine in accordance with the invention is having the characteristic features appearing from the appended claims.

The crankcase scavenged internal combustion engine according to the invention is thus essentially characterized in that the crankcase part of at least one scavenging duct to a great extent is composed of an insert part with at least one inner wall facing the crankshaft assembly and provided with the inlet, so that the crankcase part of the scavenging duct is composed of the insert part alone or in combination with the inner side of the crankcase body, and leads from the inlet to an outlet intended to connect to the cylinder part of the scavenging duct. Through this insert part with the inner wall facing the crankshaft assembly and provided with the inlet of the scavenging duct, possibilities are created to supply a horizontally-split crankcase with scavenging ducts in the crankcase part so that elongated scavenging ducts are achieved. For a vertically-split crankcase this insert part implies improved flexibility. Since the inlet of the scavening duct is located in the inner wall of the insert part the inlet of the scavenging duct can be moved by replacing the insert part. This means that with the aid of several different insert parts a specific crankcase can be adapted for many different motor applications. Adaption of both length and/or area of the scavenging ducts can be made, so that many different ratios of length/area of the scavenging ducts are achieved. Obviously this is a big advantage, both for a horizontally-split and for a vertically-split crankcase, since it offers opportunities, both in the development stage and in the serial production, to make changes quickly and easily.

Brief description of the drawings

The invention will be described in closer detail in the following by way of various embodiments thereof with reference to the accompanying drawing figures.

Figure 1 shows in perspective obliquely from below an engine body with a horizontally-split crankcase. For the sake of clarity the bottom crankcase half is not shown. Hereby the crankcase insert becomes clearly apparent.

Figure 2 shows in a cross-sectional view and seen from the direction of the crankshaft the engine body in accordance with figure 1, but here provided with the bottom crankcase half, piston and crank mechanism.

Figure 3 shows the engine body according to figure 2 in cross-section, but seen from the side perpendicularly from the direction of the crankshaft.

Figure 4 shows a vertical cross-sectional view through a vertically-split crankcase. For the sake of clarity the cross-section is cut along the centre axis of the crankshaft and hereby this axis and the crankshaft bearings are clearly shown. The insert part with the scavenging duct inlet becomes evidently visible.

Figure 5 shows a cross-section through the crankcase and the insert according to A-A in figure 4.

Description of embodiments

In figure 1 numeral reference 2 designates an engine body of an internal combustion engine. The engine body is not shown complete since the crankcase body 3 is missing for the sake of clarity. This becomes however apparent from figure 2 and 3. The engine body 2 has a so called horizontally-split crankcase with parting plane 22. This is forming a parting plane between the engine crankcase body 3 and cylinder body 5, which are screwed together with screws through holes in each flange meeting in the parting plane 22, in the conventional way. The cylinder body 5 is provided with an inlet 20 for air/fuel-mixture, an exhaust gas outlet 21 for exhaust gases as well as the top

half of the crankcase. Furthermore the cylinder body has a number of cooling fins 19. It has also two scavenging ducts 7, 7', where the latter is located on the back of the body and is therefore hidden. The scavenging duct 7 is partly arranged in a lid 26, which is fastened with screws onto the cylinder body. The lids 26 and 26' becomes apparent from figure 3. The scavenging ducts 7 and 7' could as well be cast altogether in the cylinder body 5. In this case the lids 26 and 26' are thus missing. For, the characteristic feature of the invention is the embodiment of the crankcase.

The horizontally-split crankcase 3 is not shown in figure 1, but on the other hand the insert part 9 is, which is located in the crankcase, compare figure 2 and 3. The insert part 9 consists of at least one inner wall 10 facing the crankshaft assembly and provided with its inlet 8. Through this inlet scavenging gases flow into one or two scavenging ducts in the crankcase part. In the shown example the inner wall 10 follows the crankcase body 3 over its entire length, i.e. from the one side of the parting plane 22 to the other side of the parting plane 22. In this manner the insert part 9 is clamped between the both engine body parts 3, 5 and will therefore be kept fixed in a simple way. This also contributes to a satisfactory sealing round the scavening duct 6, 6' in the parting plane 22 at the one side, in this case the right side, compare figure 1 and 2. But obviously the insert part can also be fastened in other ways into the crankcase body 3 and can even have a smaller extension angle than the shown maximal one.

As becomes apparent from figure 1 and 3 the insert part 9 has three side walls 12, 13, 14. The three side walls separate two scavenging ducts 6, 6'. Each of them leads from the inlet 8 up to an outlet 11, 11', where they connect to each cylinder part 7, 7' of the scavenging ducts respectively. Closest to each outlet 11, 11' the insert part 9 also has an outer wall 15, 15' opposite the inner wall 10. This outer wall is here arranged locally in order to improve the sealing in the parting plane 22. But it could also extend much longer, e.g. right up to the

beginning of the side walls 12 and 14. In this case two absolutely tight scavenging ducts within the insert part are created, which can be an advantage. For, the shown example is based on that the insert part 9 in combination with the inner side of the crankcase body is forming the both scavenging ducts 6, 6'. Obviously this could lead to a certain leakage where the side walls 12, 13, 14 meet with the inner side of the crankcase part 3.

The insert part does not need to have three side walls but could as well have fewer side walls. It is however preferable that the insert part, apart from the inner wall 10, has at least one side wall 12, 13, 14, which connects to the inner side of the crankcase body, e.g. it could as well have a side wall 13 located at or adjacent the middle of the inner wall 10, so that the insert part in a sectional view will get a T-shaped look, and the side wall 13 separates a scavenging duct on each side of it. This becomes apparent by removing the side walls 12 and 14 in figure 3. A sealing will then take place between the inner wall 10 and the inner side surfaces of the crankcase part. The same result would also be achieved if the side wall 13 instead should be fastened to the crankcase part 3. In that case the insert part 9 would be completely without side walls but would on the other hand co-operate with at least one wall 16 arising from the inner side of the crankcase body, so that at least two scavenging ducts are being separated. The wall 16 should then preferably be cast in the crankcase part 3 and have an adapted height so that it reaches exactly up to the inner wall 10 of the insert part. Obviously, also this middle wall could be arranged both in the insert part and in the crankcase part, e.g. a side wall 13 of the insert part could protrude down between two rising walls 16, 16' in the crankcase part. Hereby a sort of labyrinth seal between these walls would be created, and the length of the walls could be reduced somewhat, which is advantageous.

The dividing up into two scavenging ducts could also take place first at the transfer to the cylinder body 5. In this case no inner wall 13, 16, which separates the both scavenging ducts in the crankcase body 3, would be needed. As earlier mentioned the insert part 9 can have only one inner wall 10 and thereby separate only one scavenging duct in the crankcase body 3. But obviously the insert part can have two side walls 12, 14 located at or adjacent each outer sides of the inner wall 10, so that the side walls will separate a scavenging duct between them. In case the insert part 9 also has an outer wall 15, which connects the inner walls 12, 14, a scavenging duct will be created within the insert part. This will reduce the risk of leaking.

In figure 2 and 3 also the engine's piston 24, piston rod 25, crankshaft 23 with crankshaft bearing 30 and conventional crank mechanism is shown. All this is conventional and will therefore not be commented upon any further.

Figure 4 and 5 are showing a vertically-split crankcase 3, 4 with an inserted part 9. The parting plane 22 between the both crankcase bodies 3, 4 and the cylinder body 5 is here lying considerably higher than in the earlier embodiment with a horizontally-split crankcase. The centre axis 27, which shows the crankshaft's position in figure 4, has a height position that becomes apparent from the centre axis 31 of the crankcase. Compared to the earlier embodiment the parting plane 22 has thus been moved up from the centre axis 31. The both crankcase parts 3 and 4 will meet in the vertical parting plane 29. They are screwed together by means of screws through a number of screw holes 35. Each crankcase part 3, 4 has its own crankshaft bearing 30 located entirely in itself. All this is conventional and will not be further discussed. Since the crankcase body consists of two parts, 3 and 4, the insert part can be mounted into the crankcase in more ways than in the earlier embodiment. The insert part 9 is here

provided with laterally protruding collars or pins 32. These protrude into cast grooves or possibly local recesses. When the crankcase parts 3 and 4 are joined together the insert part 9 is thus kept fixed. However, the insert part could also extend right up to the parting plane 22 on both sides and be kept fixed in the same way as in the earlier embodiment. Obviously the insert part could also be anchored by screwing or glueing in one or both of the crankcase parts. What, referring to the earlier embodiment, was said about the design of the insert part 9 regarding the inner wall and side walls is valid to the same extent also in this case. It can thus consist of only one inner wall 10 and this can separate one or two scavenging ducts. In the latter case the rising wall 16 is replaced by a wall which is clamped up in the parting plane 29. The insert part 9 can thus have a number of side walls 12, 13, 14 and possible outer walls 15, 15' exactly as in the earlier embodiment.

However, in this case the insert part 9 can co-operate with a scavenging duct, which is cast into the crankcase. This becomes evident from figure 5. The inner side of the crankcase body is here arranged with an extra inner side 17 arranged from the parting plane 22 of the engine and a distance downwards in the crankcase. A cavity on both sides of the parting plane 29 is here created, so that a cast scavenging duct will exist inside the extra inner side 17. The insert part 9 can connect to the cast scavenging duct in many different ways. In the example in figure 5 is shown how the inner wall 10 of the insert part locally is adapted and slightly overlapping the inner side 17. The same is valid for one or several side walls. The side walls and a possible inner wall 10 and/or outer wall 15 can also be lead all the way up to the parting plane 22. This is suggested by the dash-dotted lines up at the parting plane and is thus a conceivable embodiment. The cast part of the scavenging duct 6 contributes to stiffening the crankcase and can thereby be advantageous. However, as

mentioned the insert part can also extend right up to the parting plane 22 so that no cast scavenging duct in the crankcase part would be needed.

A big advantage with the insert part 9 is that it contains the inlet 8 of the scavenging duct. In figure 5 is marked by arrows 36 the whole extension within which the inlet 8, with the aid of different insert parts 9, can be located in this case. This range of variation implies a substantial advantage compared with an entirely cast scavenging duct. The crankshaft angle, which corresponds to the extension of the arrows 36, should be at least 90°, preferably 120°. From figure 5 becomes apparent how the scavenging gases 28 are flowing through the inlet 8 and following the scavenging duct 6 up to the outlet 11 at the parting plane 22. A filling 34 of the scavenging ducts 6, 6' is arranged adjacent the one side of the inlet 8. For, in this case the maximum possible length of the scavenging duct is not being used. A cross wall in the insert part 9 would also be possible but could result in a certain leakage.

Consequently, by changing the insert part the length of the scavenging duct can thus be changed. But also its area can be changed. This is achieved by varying the thickness and/or position of the different walls of the insert part, i.e. the inner wall 10, the side walls 12, 13, 14 and possibly the outer walls 15, 15'. This is valid for all embodiments described.

In a case where the insert part 9 is covering a great deal of the inner surface of the crankcase, the inner dimension of the insert part would definitely affect the volume of the crankcase, so that an adaptation of the crankcase for engines with different cylinder strokes can be made. In that case the insert part could contribute to that a crankcase can be used for a number of similar engines without having unnecessary large crankcase volume for some of the engines. The insert part 9 is preferably produced of a plastic material with sufficient heat resistance, such as polyamide. Obviously it could also be produced from metal, such as aluminium or magnesium.

CLAIMS

1. A crankcase scavenged internal combustion engine(1) mainly intended for a handheld working tool, such as a chain saw, with an engine body(2) composed of at least one crankcase body(3, 4) and a cylinder body(5), which are joined together, and the engine is provided with so called elongated scavenging ducts(6,7,6',7'), which over some part of their length, i.e. a crankcase part(6,6'), extend in the crankcase body(3,4) and have their inlet(8) there, and over another part of their length, i.e. a cylinder part(7,7'), extend in the cylinder body(5), c h a r a c t e r i z e d in that the crankcase part(6,6') of at least one scavenging duct to a great extent is composed of an insert part(9) with at least one inner wall(10) facing the crankshaft assembly and provided with the inlet(8), so that the crankcase part(6,6') of the scavenging duct is composed of the insert part(9) alone or in combination with the inner side of the crankcase body and leads from the inlet(8) to an outlet(11, 11') intended to connect to the cylinder part(7,7') of the scavenging duct.

2. A crankcase scavenged internal combustion engine(1) according to claim 1, c h a r a c t e r i z e d in that the insert part(9), apart from the inner wall(10), has at least one side wall(12, 13, 14), which connects to the inner wall(10) and to the inner side of the crankcase body(3,4).

3. A crankcase scavenged internal combustion engine (1) according to claim 2, c h a r a c t e r i z e d in that the insert part(9) has a side wall(13) located at or adjacent the middle of the inner wall(10), so that the insert part in a sectional view will get a T-shaped look, and the side wall(13) separates a scavenging duct on each side of it.

4. A crankcase scavenged internal combustion engine(1) according to claim 2, c h a r a c t e r i z e d in that the insert part(9) has two side walls (12,14) located at or adjacent each of the outer sides of the inner wall(10), so that the side walls (12,14) will separate a scavenging duct between them.

5. A crankcase scavenged internal combustion engine(1) according to claim 4, c h a r a c t e r i z e d in that the insert part(9) has yet another side wall(13) loacted at or adjacent the middle of the inner wall(10), so that the side walls(12,13,14) will separate two scavenging ducts.

6. A crankcase scavenged internal combustion engine (1) in accordance with any one of the claims 2-5, c h a r a c t e r i z e d in that the insert part (9) also has an outer wall (15,15') opposite to the inner wall (10).

7. A crankcase scavenged internal combustion engine(1) according to claim 1, c h a r a c t e r i z e d in that the insert part (9) co-operates with at least one wall (16, 16') rising from the inner side of the crankcase body, so that at least two scavenging ducts are being separated.

8. A crankcase scavenged internal combustion engine (1) in accordance with any one of the preceding claims, c h a r a c t e r i z e d in that the engine body (2) is composed of one crankcase body (3), in which the insert part(9) is located, and a cylinder body(5).

9. A crankcase scavenged internal combustion engine (1) in accordance with any one of the preceding claims, c h a r a c t e r i z e d in that the engine body(2) is composed of two crankcase bodies(3,4), between which the insert part (9) is located, and a cylinder body (5).

10. A crankcase scavenged internal combustion engine(1) according to claim 9, c h a r a c t e r i z e d in that the inner side of the crankcase body is arranged with an extra inner side(17) arranged from the parting plane(22) of the engine towards the cylinder body(5) and a distance downwards into the

crankcase in order to at least at its end in the crankcase co-operate with the insert part(9), so that they together form the crankcase part (6, 6') of at least one scavenging duct.

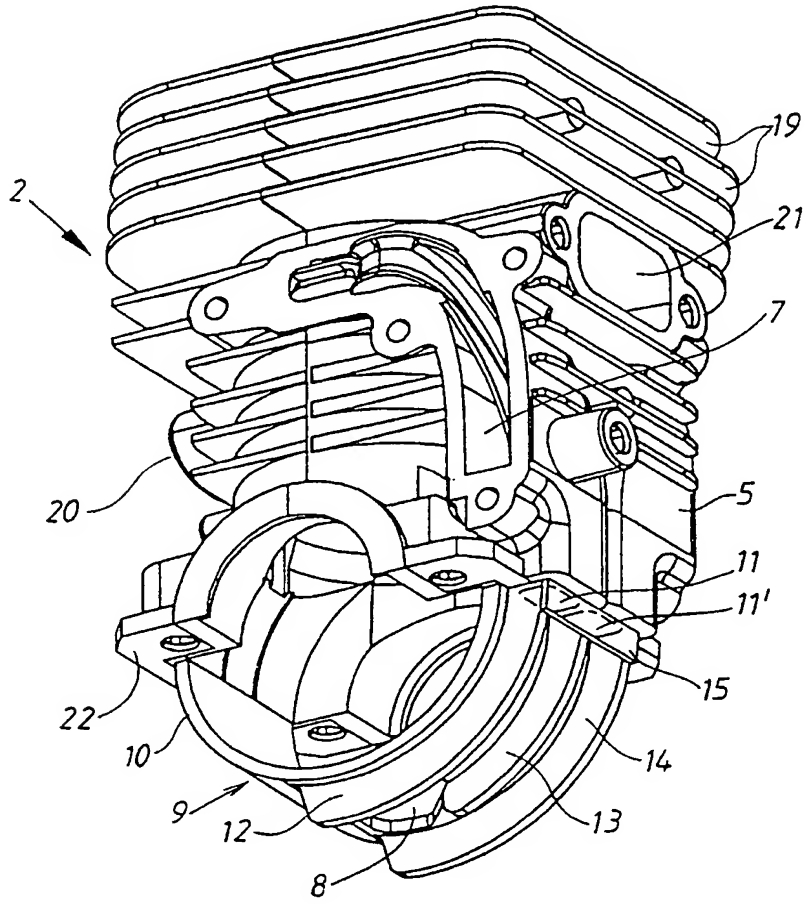

FIG. 1

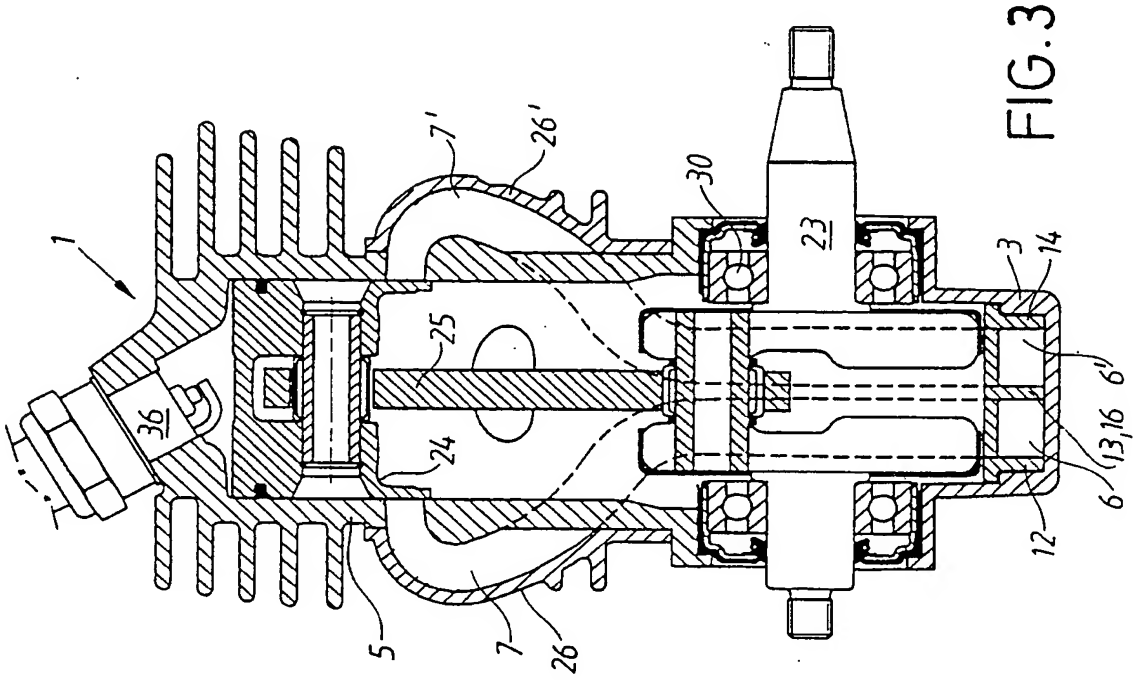
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FIG.3

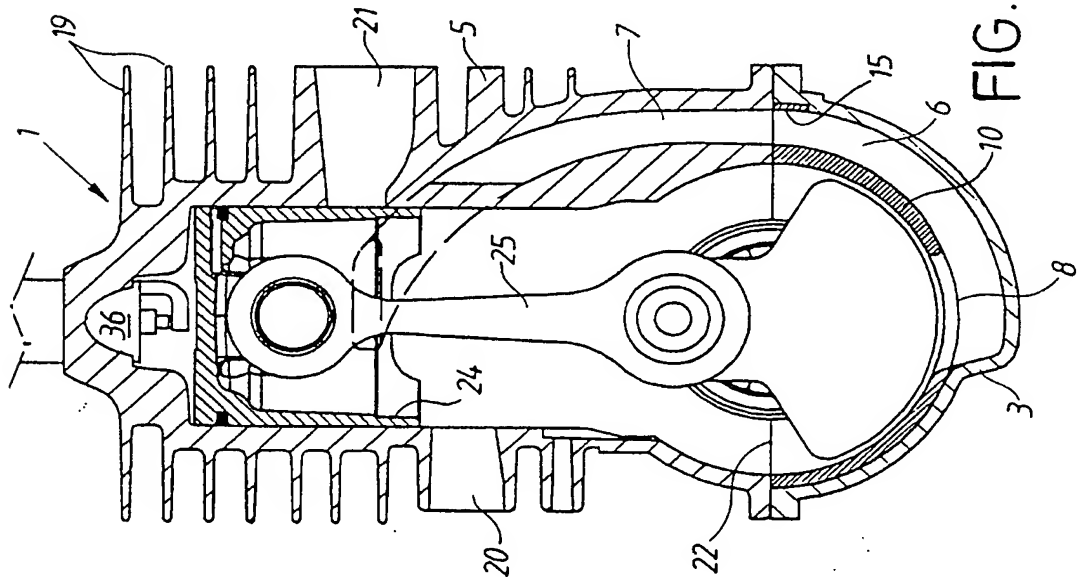
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FIG.2

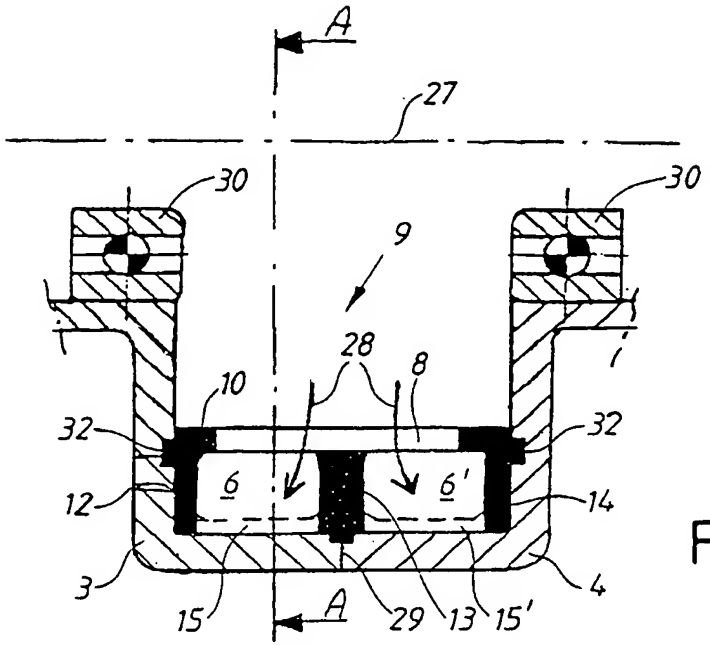
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FIG. 4

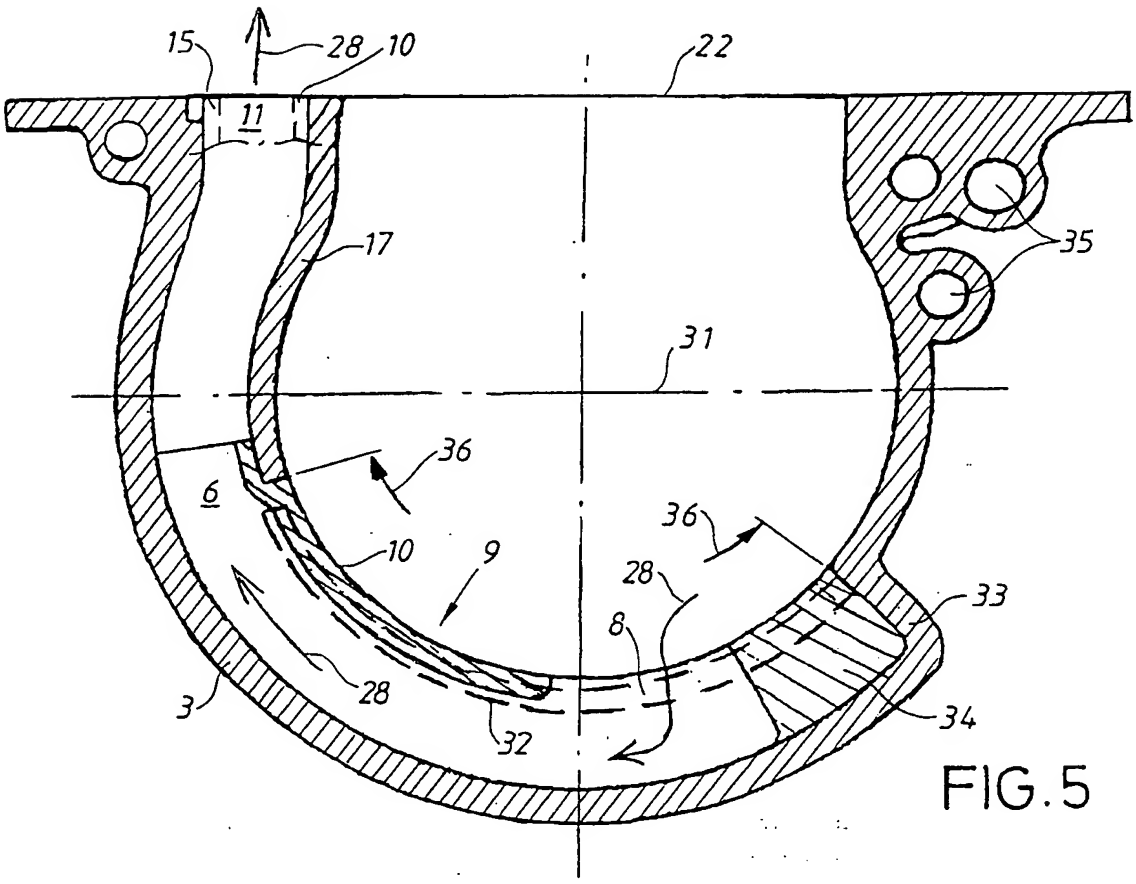
15
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FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/01961

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F02B 33/04
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: F02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4213431 A (ONISHI), 22 July 1980 (22.07.80), figures 2-7	1,2,8,9
A	--	3-7,10
X	US 4204489 A (ONISHI), 27 May 1980 (27.05.80), figures 2-6	1,2,8,9
A	--	3-7,10
X	US 4204488 A (ONISHI), 27 May 1980 (27.05.80), figures 2-7,10	1,2,8,9
A	--	3-7,10

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Name and mailing address of the ISA Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Björn Kallstenius / MR Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 99/01961

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